the same time that the excellence of the result increases with the artistic skill of the author.

"I particularly wish it to be understood that I regard the present maps as imperfect, and merely as drafts, although tolerably complete as maps go, and well filled in. Any one who has worked on a map will have found, that to produce one which shall be satisfactory as a picture to the eye of another observer using a different telescope, it is very necessary for him to go over his map at different times, using different apertures. This has not, at present, been done for these maps. The sensible presence of twilight during the months of June and July has been another source of imperfection. For, as the nine maps are very nearly of equal spherical area, they ought to be very accurate guages of the polar region; but, owing to the cause named, and to the effect of thin fog on every night given to map No. 3, this relation is nullified for the present.

"I have distinguished by wings all those stars which are stated by Argelander in his *Uran. Nova* to be visible to the naked eye; by the letter D all those stars which, under a power of 28, appeared to consist of two components, too close to be represented together on the map; and by the letter N all places which appeared nebulous, and at which I should halt in sweeping for comets, although it is very possible that some of them may be clusters easily resolvable under moderate powers. Other stars I have in all cases distinguished by dots of different sizes; a method of representing magnitudes which, as more pictorial, I prefer to any other.

"I may mention, in conclusion, that during the formation of these maps I was soon struck with the frequency with which little meteoric sparks passed my field of view, often leaving behind little trains of light, and that, finding it an almost constant phenomenon, I took to noting down their paths on my working-maps as I proceeded. In this way I have collected 49 little paths of very various directions, but among which one may, perhaps, trace the existence of a little shoal crossing the pole in lines generally parallel to the meridian from 1^h to 13^h R.A. On the second night of the Laurentius stream this year, there was a marked increase in the number seen; seven were marked down, while others flew through the field too quickly to be caught. As I also perceived increased activity on several cold and windy nights, these minute telescopic meteors appear to consist of two classes, like their larger brethren, those of the naked eye, namely, one of a cosmical and one of an electrical origin."

Redhill Observatory.

On a Mode of Mounting a Telescope equatoreally.

By Mr. Joseph Hopkins.

"Having recently taken out a patent for 'a mode of obtaining a straight line parallel to the earth's axis, or of making the axis of a tube or the axis of a telescope parallel thereto,' which (amongst

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other purposes) may be applied to the construction of sun-dials by which minute portions of time might be marked, or to the production of equatoreal motion in a telescope without the preparatory aid of levels or divided circles, and without the usual preliminary requirements of a knowledge of the latitude and direction of the meridian, I am anxious to lay before you the application of the principle to an instrument which may, perhaps, be not inaptly named 'the portable observatory.'

"Upon a common tripod telescope stand, a brass tube is so mounted as to have a horizontal and a vertical motion, each of which may be clamped so that the direction of the axis of the tube being once determined its position may be rendered permanent.

"The tube is 5 inches in length. If now at one end of it were inserted an eye-piece, in the centre of which was drilled a hole about one-tenth of an inch in diameter, and at the other end an object cover with a central circular aperture of the diameter of a quarter of an inch, the eye of an observer on looking through the smaller of these apertures would take in a field of view, the circumference of which would be equal to that of the circle which *Polaris* apparently describes round the true polar point, and if by the requisite horizontal and vertical motions these circumferences be made to coincide their centres will also coincide, and the axis of the tube will be parallel to the earth's axis.

"The coincidence here spoken of may be nearly enough obtained where a plain tube only is used, by viewing the pole-star on that part of the circumference of the circular diaphragm nearest to the constellation *Cassiopeia*; but, as in the instrument now brought before your notice, a small telescope is used, the axis of which is to be made parallel to the earth's axis, I shall proceed to show the mode of obtaining this parallelism.

"On the outside of the tube of the small telescope are two circular rings, which are carefully ground and fitted into collars in the brass tube: an axis of the telescope is then made to coincide with the common axis of these collars, and the centre of its diaphragm is made coincident with this axial line, the diameter of the diaphragm being such as to give a field of view to the telescope of 2° 57′ being double the north polar distance of *Polaris*.

"A brass sector, shown in the drawing, is made to move round the upper part of the brass tube at right angles to it, carrying an index and two small perforations, through which latter mentioned, when the stars ε and ζ *Ursæ Majoris* are seen by the observer, the eye taking in at the same time the field of view of the small telescope, the position to which *Polaris* must be brought on the circumference is pointed out by the line of light seen through the index.

"As a test of the correctness of its place thus found, turn the small telescope about its axis in the collars of the tube, when, through an entire revolution of the telescope, the star should continue to cling, as it were, to the same point of the circumference of the diaphragm.

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"The axis of the collars of the tube being thus made parallel to the earth's axis, we remove the small telescope and sector, insert the axis, which is fastened by clips to the larger telescope, and fitted by rings of bell metal into the collars of the tube, attaching to it the right ascension circle with its clamp.

"It is evident that to whatever height the telescope be elevated, if it be turned about this axis, it will move in planes parallel to the equator; and if it be directed to a star, a motion given to it from east to west by the hand or by a hook's joint, will serve to keep the object in the field of view.

"I have chosen, however, to give motion to the telescope by the action of a floating syphon, the weight carried by the float being connected with the right ascension circle by a cord clamped in one of its grooves.

"The upper edge of this circle is exactly 24 inches in circumference, the lower edge 25 inches nearly, the former having a proportion to the latter equal to that of the sidereal to the mean lunar day. Each of these circumferences is grooved to the same depth. The thickness of the cord should be double the depth of the groove.

"The large cylindrical pan is about 18¾ inches in diameter: it contains in a depth of 12 inches 95·7 pints. This quantity of water should be run off by the syphon in 12 sidereal hours; the rate (which should be adjusted while the telescope is in motion) is obtained by raising or lowering the syphon by the rack and pinion, till it delivers 1 gallon in 1 mean solar hour, or 1 pint in 7½ minutes.

"The rate thus adjusted, if the motion of a star is to be followed, place the cord in the upper — if of the moon in the lower — groove of the right-ascension circle, and let it hang by the small plummet over the pulley fixed to one of the legs of the stand.

"The telescope directed to the object, the cord clamped, and the syphon in action, no movement of the instrument will take place till the cord is so stretched as to overcome the friction of the collars in the tube; we, therefore, turn the milled head at the upper edge of the pan, which, by opening the stop-cock, causes the floating weight to sink rapidly; this motion being stopped when the object appears in the centre of the field of view, the action of the syphon alone will cause it apparently to remain stationary.

"I wish it to be distinctly understood that the instrument now submitted to your notice was designed to show (independently of its application to the production of equatoreal motion) the methods by which an extended wire, the axis of a tube, or the axis of a telescope, might be made parallel to the earth's axis to a sufficient degree of exactness to make it available for astronomical observations.

"Other simpler forms might be adopted where one telescope only need be used, or a telescope and its finder, the latter having a field of view of 2° 57′ might serve to determine the polar axis, and be so mounted as to produce the equatoreal motion required.

"Where very powerful telescopes are used, the smaller one used

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for finding the polar axis might have a field of view of 3°, and the exact position of *Polaris* within the circumference might be determined by a micrometer adapted for the purpose; this would admit of the requisite corrections for refraction.

"Such a telescope attached in the same manner as a finder to the polar axes now used in observatories would serve readily to test the accuracy of their position, while in the Fraunhofer form of equatoreal it may be substituted for the polar axis, when we should obtain the advantage of making the axis of one telescope the fixed axis about which another may be made to revolve.

"As differences in the temperature of the water occasion some little variation of rate in the quantity delivered by the syphon, the rack-work should be graduated for these differences, or self-regulating clepsydras may be constructed either by using two cisterns and two syphons (one of the latter acting as a supply pipe to the cistern carrying the weight connected with the telescope), or if one cistern only be used by a thermometer carrying a piston attached to the syphon, the bulb of the thermometer being fixed under the lower surface of the float.

"If the telescope be not well balanced about its centre of gravity, more or less weight will be required to move it, as its direction is varied. If, however, the float cover a large surface of water, and the syphon, when adjusted for the mean temperature, be at some depth below this surface, no perceptible variation of rate will be occasioned.

"The action of the clepsydra produces a smoothness of motion not to be surpassed; and I feel assured it might be adapted to the requirements of an observatory, more especially as its rate may be so readily brought under the immediate control of the observer."

Description of a Miniature Observatory erected at No. 200 *High Street, Exeter.* (Latitude 50° 43′ 19″·45 N., and longitude $0^h\ 14^m\ 7^s$ W.) By Messrs. Ellis and Son.

(*Communicated by Dr. Lee.*)

This Observatory is built over workshops at the back part of the premises in the above locality, about 40 feet above the ground, and at 175 feet above the mean level of the sea, which elevation commands the northern horizon (48° below pole) as well as 36° of south declination. The upper chamber is 3 feet 1 inch wide (except that portion which falls into the return of the chimney, and which is a little wider), 5 feet 8 inches long, and 6 feet high. It has north and south doors, a chicket window, forming a convenient desk and cupboard, and a skylight, in the direction of the meridian, which is readily opened by means of a short lever. The eastern wall is painted; the others canvassed and papered. The doors and meridional opening are painted black. The roof being flat is covered with zinc.

The transit, a 20-inch instrument by Troughton, is mounted on